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Zimbabwe Journal of Educational Research

HRRC, Faculty of Education

University of Zimbabwe

P. O. Box MP167

Mount Pleasant

HARARE

Zimbabwe

E-mail: hrrc@education.uz.ac.zw or f_zindi@hotmail.com

Tel: +263-04-303271 or 303211/9 Extn: 16002/3

Contents

Page

Towards the Development of African Psychometric Tests <i>Fred Zindi</i>	149
Determinants of School Attendance among Children with Disability in Zimbabwe and Implication on Disability Policy <i>Kefasi Nyikahadzoi, Belamino K. Chikwaiwa & Edmos Mtetwa</i>	167
HIV and AIDS Awareness among Children with Mental Retardation in Masvingo Urban: A Teacher's Viewpoint <i>Francis Emson Dakwa, Albert Manyowa, Absalom George Qawe Bhebe, Regis Chireshe & Edward Ntare Rutondoki</i>	182
Inclusion or Integration: Towards Conceptual Clarity in the Provision of Special Needs Education in Zimbabwe <i>Oswell Hapanyengwi-Chemhuru</i>	201
The Missing Link in the Medium of Instruction Controversy: Voices of Pupils and Teachers <i>Morrin Phiri, Darmarris Kaguda, & Dumoluhle Mabhena</i>	117
Peace and Conflict in Zimbabwe – A Call for Peace Education (A Contribution to the Constitution Making Process) <i>Ngoni Makuva</i>	240
Female Leadership Dilemmas in Primary Schools: A Case Study of Five Primary Schools in Harare Province (Zimbabwe) <i>Tichaona Mapolisa, Ephraim Mhlana, Nelson Chabvonga Madziyire & Zvinaiye Chimwadzwa</i>	261
Computer Assisted Assessment and the Role it Plays in Educational Decision Making and Educational Justice: A Case Study of a Teacher Training College in Zimbabwe <i>Michael Kainose Mhlolo</i>	277

Towards the Development of African Psychometric Tests

Fred Zindi, Faculty of Education, University of Zimbabwe

Abstract

Test development and psychometric principles are among the more difficult topics for Psychology students in Africa. In this article, a look at how psychometric tests designed in Western countries and used in African countries is made. Thirty six masters degree students from past educational psychology programmes were given an assignment to develop a psychometric test to replace the WISC-R using African cultural norms. The students were asked to conceptualise tests, write items, administer the tests, perform item analysis on the data, and calculate the instruments' reliability and validity. At the end they came up with a draft psychometric instrument to replace the WISC-R which was to be finalized and pilot-tested on a sample of 2000 pupils aged between 12 and 13 years which is in keeping with international best practices. The success of the adapted WISC-R, which was named the ZIPE test, would determine further adaptations of other psychometric instruments such as Personality, Aptitude and Interest Inventories.

Introduction

For many years, African countries have depended on the use of western designed psychometric instruments such as Raven's Progressive Matrices, British ability Tests WISC-R Wrat Scale, Goodenough Draw A Person Test, WIPPSI and the Minnesota Multiphasic Personality Inventory etc. Such tests, standardized in Western cultures using western cultural values, have been found to be useful to a certain extent. In many cases, interpretation of results from Western designed tests have however been distorted to suit western stereotypes about other nations (Zindi, 1994).

African nations are now coming together with the aim of developing their own psychometric instruments which are based on African values, beliefs and cultural norms. The Botswana government is at the moment in the process of developing the framework for the

implementation of locally standardized psychometric tests. The Zimbabwean government is following suit.

One of the central functions of the Schools' Psychological Services in Zimbabwe is the assessment of abilities of school children for placement purposes. To this end, the most popular instrument in use up to this day is the Wechsler Intelligence Scale for Children – Revised (WISC-R) where test administration procedures practised in western countries, including discontinue rules are strictly adhered to. The WISC-R has been adapted from the Stanford – Binet I.Q. tests which were originally developed by the French psychologist, Alfred Binet.

The key concepts behind any classical psychometric test are its reliability and validity (Michell, 2009). The question to ask about the tests in use today is: “Are these tests, which are designed in western countries valid and reliable for use on African children?”

Recent research has shown that it is necessary to analyse culturally transported tests to identify items which do not function equivalently for both cultural groups (Insua, 1983). Despite translating the WISC-R into local language, there are likely to be discrepancies in performance between children who speak English as a foreign language and those whose mother tongue is English even after educational levels, sex and ages of the two cultural groups have been held constant. Even in the same country, differences in cultural groupings can determine differences in test performance. Higher scores in test performance often come from the group where the test designer belongs. In America, Psychometric tests are often designed by White middle class psychometricians. These tests do not often function equivalently when administered to Black working class citizens as they do to white middle class citizens (Insua, 1983).

The differences in ethnicity of the two populations have been found to have an effect on performance (Mpofu, 1991). The assumption made when foreign tests are used for assessing African students is that score distributions for African children are identical to those for the norm samples used in the U.S.A. or Britain in the standardisation process. This has been proved to be the wrong assumption and it is

for this reason that Africans should make an effort to develop psychometric instruments which are standardised using African norm samples. For instance, items on the WISC-R designed in the West for 12 year olds, may be verbally loaded to those individuals who are learning English as a second language. Giving the same vocabulary test to 12 year old Africans might compound the problem of adequate assessment. Items should therefore be developed based on African values, beliefs and cultural heritage in order to give credible information about African students' learning and performance.

The psychometric principles which underlie tests are one example of difficult methodological or statistical topics of which students often develop only the most rudimentary understanding. Yet these topics have been referred to as "the most important aspect of scientific psychology for many students because tests are so much a part of modern life" (Brewer et al., (1993), p. 174). To promote student interest in this inherently unexciting material, instructors teaching psychometrics often have students select, administer, and score already published tests. However, while these activities provide valuable experience with testing, they do not promote a thorough understanding of the theoretical and psychometric foundations of tests and testing.

In this article, psychometric theory and the critical aspects of test development, including: use of encyclopedia of available tests such as the *Mental Measurements Yearbook* (Buros, 1992), the conceptual process in test construction, item scaling, item development and analysis, the estimation of reliability and validity, norms and standardization, and practical and ethical concerns regarding test administration, as shown by Flanagan (2012), among other topics are described. Using this approach, it was observed that students become quite enthused about learning this technical material and they appear to comprehend thoroughly the meaning and purpose of psychometric principles. It is through this understanding that it was hoped students who have just completed M.Sc Educational Psychology programme at the University of Zimbabwe would develop their own Psychometric tests which are more relevant and suitable for Zimbabwean needs.

Method

Thirty six past Masters' degree students in Educational Psychology were exposed to a variety of western made psychometric tests such as Raven's Progressive Matrices, Wechsler Intelligence Scale for Children (WISC), Kaufman Assessment Battery, Minnesota Multiphasic Personality Inventory (MMPI), The Strong Interest Inventory and the Differential Aptitude Tests and were shown how these function. In groups of four, they were asked to brainstorm on the strengths, weaknesses, opportunities and threats (SWOT Analysis) of using such tests to African pupils. Each of the nine groups was tasked to develop alternative and more relevant items under each specific heading shown on the WISC-R e.g. Vocabulary, Comprehension, Block Design, etc. The items coming under each WISC-R heading from each group were then combined to form the draft test which consisted of the Verbal Scale and The Performance Scale.

(It should be noted that, while a course in statistics was not a prerequisite for this course, more than 80 per cent of the 36 students had had such a course. The students' first project was to develop a test of "maximum performance" which is the equivalent of the WISC-R.)

After three weeks, the students had developed the first test blueprint which they decided to call the Zimbabwe Psychological Evaluation (ZIPE) test as shown below:

ZIPE (Rough draft)

For form one pupils in Zimbabwean schools aged 12 – 13 years

Verbal Scale

Information

Each item is scored 2 for correct answer, 1 for close to correct answer and 0 for wrong answer.

- 1) April 18 is which holiday in Zimbabwe?
- 2) Give three methods of traditional marriage in Zimbabwe
- 3) Long ago in Zimbabwe, the ancient people wore clothes

made of what?

- 4) What did polygamy symbolise in African traditional culture?
- 5) The traditional role of boys and men was hunting whilst that of girls and women was.....
- 6) What is a blacksmith?
- 7) In your native language, a skilled hunter is called a.....
- 8) In your native language, a successful farmer is called.....
- 9) Which country shares the eastern border with Zimbabwe?
- 10) In which direction does the sun set?
- 11) Which nutrient do we get from vegetables?
- 12) State one method through which HIV is spread.
- 13) What does AIDS stand for?
- 14) Long ago, Kings were buried in.....
- 15) Give one indigenous fruit.
- 16) In African tradition, where would sick people go for treatment?
- 17) Instead of using clocks, what did ancient people use to determine time?
- 18) State two signs of physical maturity in boys.
- 19) State any two items that are used to pay lobola.
- 20) Which bird is associated with witchcraft in Zimbabwe.
- 21) Which cell-phone network is not Zimbabwean?
A. Telecel B. Vodacom C. Netone
- 22) Which of the following is a traditional crop grown in Zimbabwe?
A. Rice B. Rapoko C. Peas

- 23) From what country did Zimbabwe become independent in 1980?
- 24) What is our staple food in Zimbabwe?
- 25) Who was the first president of Zimbabwe?
- 26) Which distance is likely to cover 293 kilometres, Harare to Masvingo or Harare to Chegutu?

Comprehension

Read the story which is attached on a separate sheet of paper, and then answer the questions below.

Each item is scored 2 for correct answer, 1 for close to correct answer and 0 for wrong answer.

- 1) If you meet an older person, who is supposed to greet the other?
- 2) What should you do when you see a red robot signal?
- 3) What is a rain gauge used for?
- 4) What is the fastest mode of transport?
- 5) Why is it important for cars to have number plates?
- 6) Why should we immunise children?
- 7) Why is it good to hold elections by secret ballot?
- 8) Why do we have prefects at school?
- 9) Your mother is seriously ill in hospital and you are required to attend a friend's birthday party? What would you do?
- 10) State two reasons why we need the police?
- 11) You pick up a lost \$50, 00 in the classroom and you need to pay \$50, 00 exam fees and it is the deadline. What would you do?
- 12) Why do we have to put stamps on letters?
- 13) What should you do if a boy or girl much smaller than you starts to fight with you?

- 14) Why should we iron clothes?
- 15) Give two reasons why prostitution is bad?
- 16) Why is it necessary to have a birth certificate?
- 17) Why should people put money in a bank?

Similarities

Each item is scored 2 for correct answer, 1 for close to correct answer and 0 for wrong answer.

- 1) Soccer - netball
- 2) Elbow - knee
- 3) Banana - mango
- 4) Car - train
- 5) Red - yellow
- 6) Rectangle- square
- 7) Lion - elephant
- 8) Cattle - buffalo
- 9) Pen - pencil
- 10) Nephew - niece
- 11) Orange - lemon
- 12) Teacher - parent
- 13) School - college
- 14) Musician - sculptor
- 15) Baboon - monkey

Think of ten more similarities

Arithmetic (Oral-60 sec per item)

Each item is scored 2 for correct answer, 1 for close to correct answer and 0 for wrong answer.

- 1) What is the sum of 3; 8 and 4?

- 2) What is the difference between 20 and 10?
- 3) Find the average of 1; 2 and 6.
- 4) What is the product of 2; 3 and 6?
- 5) What fraction of a dollar is 30 cents?
- 6) In a basket there are 15 eggs. If 8 of these break, how many eggs remain?
- 7) A widow planted 14 carrots in the morning and 7 in the afternoon. How many carrots were planted altogether?
- 8) A girl had \$16 in her purse. She lost half of this amount. How much money did she remain with?
- 9) 32m of ribbon are cut into 4 equal pieces. What is the length of each piece?
- 10) Three sisters have \$27 they want to share equally among themselves. How much does each get?
- 11) Mother has 36 dresses. She sells 20 of these dresses to a club. How many dresses are left?
- 12) A boy had 8 books each costing \$9. What was the total cost of the books?
- 13) Half of a worker's salary is \$43. What is her full salary?
- 14) 58 oranges are shared equally among 7 children. Find the remainder.
- 15) In a club of 36 pupils, $\frac{1}{3}$ are girls. How many girls are in the club?
- 16) Everyday a retailer sells 7 crates of cool drink. How many crates are sold in a 7-day week?
- 17) 6kgs of sugar cost \$12. What is the cost of $\frac{1}{2}$ kgs?
- 18) Find one quarter of an hour.
- 19) What is the area of a square of sides 6cm?
- 20) What is the sum of $\frac{1}{2}$ of 8 and $\frac{1}{2}$ of 10?

- 21) In a school lunch begins at 12.30 p.m. A teacher leaves the class 5 minutes earlier. What time does he leave?
- 22) John has 5c. Mary has twice as much. How much money do they have altogether?
- 23) A retailer bought goods worth \$100 at a discount of 2%. What is the discount?

Vocabulary

Each item is scored 2 for correct answer, 1 for close to correct answer and 0 for wrong answer.

Give meanings of the following words (some of the meanings have been done for you).

- 1) Hero
- 2) Wheelbarrow
- 3) Harvest Reaping and gathering-in of grain
- 4) Unity
- 5) Donkey
- 6) Obey
- 7) Cart
- 8) Rainbow Arch showing sequence of colours
- 9) Village
- 10) Kraal
- 11) Athlete
- 12) Chief
- 13) Beer
- 14) Team
- 15) Mealie-meal
- 16) Cow dung
- 17) Divorce Legally dissolve marriage between

- 18) Aggression
- 19) Associate
- 20) Repetition
- 21) Position
- 22) Pumpkin
- 23) Participate
- 24) Isolate
- 25) Destination Place to which a person or thing is going
- 26) Sea
- 27) Indigenisation
- 28) Government
- 29) Empowerment
- 30) Foreigner
- 31) Genuine
- 32) Target
- 33) Vicinity Neighbourhood
- 34) Substitute
- 35) Decoy Lead into a trap
- 36) Dominate
- 37) Consequence Result

Lateral thinking

- 1) In the following line the two numbers which are exactly alike are underlined:
2134 5163 1243 2785 2134 2143
- 2) Now, underline the two numbers that are exactly alike in the following line:
 6758 2876 7329 2786 7932 2876 3851

- 3) Suppose it were Monday today, what day would it be the day after tomorrow?.....
- 4) CAR FATHER ASKED MY TO NEW
HE A BUY
- 5) When the above words are put in the proper order, they make a sensible sentence. Write them here in the correct order:
- 6) The following statement can be completed by one of the words in brackets:
- 7) ANIMAL is to LION as BIRD is to (Cat, Sparrow, Little Mouse). That word is Sparrow, for a sparrow is a kind of a bird, just as a lion is a kind of animal: so a line has been drawn under it.
- 8) Each of the following sentences can be completed by one of the words in brackets. Look for this word and draw a line under it.
- 9) Fish is to swim as bird is to (Fly, Beak, Air, Bark).
- 10) This is to These as that is to (There, Those, Them, Here).
- 11) Cut is to knife as write is to (Book, Writing, Pen, Read).
- 12) Pig is to pork as sheep is to (Beef, Lamb, Mutton, Calf).
- 13) Foot is to boot as hand is to (Arm, Head, Long, Glove).
- 14) Minute is to second as hour is to (Day, Week, Minute, Year).
- 15) John was lighter than James, and James was the same weight as William. Who was heavier, John or William?.....

Performance Scale

Picture completion

In each of the pictures, given on a separate sheet of paper, state which part is missing.

Picture

- 1) woman
- 2) donkey
- 3) hand
- 4) clock
- 5) dog
- 6) belt
- 7) door
- 8) scissors
- 9) cow
- 10) hut
- 11) tree
- 12) bus
- 13) television
- 14) bicycle
- 15) cart
- 16) policeman
- 17) umbrella
- 18) three-legged pot
- 19) ladder
- 20) car
- 21) shirt
- 22) boots
- 23) watch
- 24) pen
- 25) elephant

Missing part

- eye
- ear
- finger
- number 10
- tail
- hole
- hinge
- screw
- hoof
- door
- leaves
- wheel
- aerial
- saddle
- axle
- hat
- spokes
- leg
- rung
- steering wheel
- buttons
- shoe lace
- belt
- clip
- tusk

26) bag

zip

27) cat

whiskers

Object assembly

Assemble the pieces of pictures give on a separate sheet of paper to build the following items.

- 1) Cow
- 2) Aeroplane
- 3) Human portrait
- 4) Haulage truck
- 5) Plough

Coding (30 sec per item)

A	B	C	D	E	F	G	H	I	J	K	L	M
1	2	3	4	5	6	7	8	9	10	11	12	13

N	O	P	Q	R	S	T	U	V	W	X	W	Z
14	15	16	17	18	19	20	21	22	23	24	25	26

Use the code above to find the following words:

Example: 13; 1; 14 = man

- 1) 5; 4; 20
- 2) 3; 1; 20
- 3) 4; 15; 7
- 4) 16; 12; 1; 25
- 5) 20; 5; 19; 20
- 6) 13; 15; 14; 5; 25

- 7) 2; 1; 2; 15; 15; 14
- 8) 19; 3; 8; 15; 15; 12
- 9) 16; 18; 1; 25; 5; 18
- 10) 26; 9; 13; 2; 1; 2; 23; 5

Picture arrangement

With the pictures given on a separate sheet of paper, arrange them to make the following situations:

Situations 1

- i) Man boarding a bus.
- ii) Overturned bus.
- iii) Ambulance.
- iv) Injured man on stretcher and nurse.

Situation 2

- i) Boy walking.
- ii) Boy at river.
- iii) Clothes (belonging to boy).
- iv) Boy swimming.

Block design

Materials

9 blocks (cubes) coloured red on two sides, white on two sides, and red/white on two sides.

Directions

- 1) Examiner demonstrates designs 1 and 2 and after that the examinee makes a similar design. Time limit: 45 sec.
- 2) Designs 3 to 11 are done by examinee from designs on cards.
Scores for designs 3 to 11 with time bonuses included

Design	Time	Points with time bonus			
	Limit	7	6	5	4
1)	45 sec	1-10	11-15	16-20	21-45
2)	"	1-10	11-15	16-20	21-45
3)	75	1-10	11-15	16-20	21-75
4)	"	1-10	11-15	16-20	21-75
5)	"	1-10	11-15	16-20	21-75
6)	"	1-25	16-20	21-25	26-75
7) (9 blocks)	120 sec	1-25	26-35	36-55	56-120
8 (9 blocks)	120 sec	1-40	41-55	56-75	76-120
9 (9 blocks)	120 sec	1-40	41-55	56-80	81-120

Maximum score: 65 points

End of ZIPE Test (Maximum time allowed: 1 ½ hrs)

Item analysis

The ZIPE test was subjected to an item analysis in which all 36 students participated and each student received a printout including the raw scores, item discrimination values, item difficulty values, and item response percentages (i.e. distracter values). The class was given basic instruction in the use of the Statistical Package for the Social Sciences (SPSS) software (Norusis, 1988). Each student derived descriptive statistics and a frequency distribution for each item of the inventory. In addition, students used the SPSS reliability routine to derive item discrimination indices (item-total correlations) and estimates of internal consistency (Cronbach's alpha).

Based on the item analysis, the class decided which items to delete and which items to retain for the pilot test. The instructor was the final arbiter for such decisions. Discussion of the deleted items highlighted factors that may have contributed to their poor psychometric performance (e.g. vague questions or response alternatives, confusing wording).

Test revision

Working in their groups, this time equipped with the full draft of the ZIPE test, students selected only the most psychometrically sound items, eliminating those with low item-discrimination indices or restricted variance and those items that could not easily be revised. Reliability coefficients were recalculated based on the retained items. The revised inventories were administered to a different group of general psychology students, and based on its discriminant validity, the data served as the basis for a pilot study on 2000 pupils at randomly selected schools throughout Zimbabwe's ten provinces.

Discussion

It would seem, then, that with the experience gained from the development of the ZIPE test which has been adapted from the WISC-R, students are ready to venture into the development of other psychometric instruments in the areas of Personality Inventories, Differential Ability Scales, Aptitude Tests and Interest Inventories.

It is important to note that in carrying out this exercise, consultation is often required at every step from conceptualization through item writing, statistical analysis, and final report preparation. According to international best practices, a standardized psychometric instrument which serves a nation and which is recognized internationally should have been administered among at least 2,000 participants before validation. It has already been established that standardized tests are biased and unfair to persons from cultural and socio-cultural groups since most psychometric tests reflect largely white, middle class values and they do not reflect the experiences of and the linguistic, cognitive and cultural styles and values of minority or foreign groups. Hopefully, with progress, Africa will have its own psychometric test kits which are more culturally relevant. In addition, like the M. Sc. Educational Psychology students, we find that the effort is justified by the rewards – students who understand and can use the technical processes of test development, and who contribute to the development of nations by introducing new ideas will assist in the revolutionizing of African educational achievements.

Conclusion

It is envisaged that the results from the field study of the ZIPE Test will indeed develop the way forward for African education systems. The field test will determine the robustness of the ZIPE test and it is envisaged that it will compare favourably with the WISC-R. All new systems have got a beginning and this is the beginning of psychometric testing in Africa. When such systems are in place, it is hoped that Africans will kiss goodbye to Western-made tests coming from the likes of Psychological Corporation and this should save governments the much needed foreign currency used to buy these tests. The theme 'African solutions for African problems' gives hope towards the construction of psychometric instruments which are more relevant and suitable for Zimbabwean and eventually African needs, and that theme seems to work here.

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